# BRAIDED COMPOSITE RODS FOR CIVIL CONSTRUCTION APPLICATIONS

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## RESUMO

The use of fibre reinforced composite rods as concrete reinforcement material seems to be an effective solution to overcome durability problems of traditional steel reinforced concrete structures. The main advantages of fibre reinforced composite materials over steel include the excellent corrosive resistance, mechanical properties similar to steel, high strength-to-weight ratio and excellent fatigue resistance, among others [Alsayed et al, 2000], [Lees, J. M., 2001].

Typically, fibre reinforced composite rods are produced by pultrusion, although, besides this technique, composite rods can also be produced using braiding techniques [Kadioglu, F. & Pidaparti, R. M., 2005], [Saikia, B. et al, 2005].

Braiding is a low cost technique that allows in-plane multiaxial orientation, conformability, excellent damage tolerance and core reinforcement [Soebroto et al, 1990], the production of ribbed structures and a wide range of mechanical properties may be improved when the core braided fabrics are reinforced with the appropriate type of fibres [Fangueiro et al, 2004, 2005 & 2006].

The current research work deals with the development of braided reinforced composite rods for civil engineering applications, namely to reinforce concrete structures as a substitute of steel rebars. The mechanical properties of composite rods, produced by braiding, are influenced by the type of fibre used as braided fabric core reinforcement, among other parameters.

The objective of this experimental work is to evaluate the influence of the type of core reinforcement fibres on the mechanical performance of braided reinforced composite rods. Several samples of braided reinforced composite rods were produced using polyester fibres, for the production of braided fabrics, E-glass, carbon and HT polyethylene fibres, as braided fabrics core reinforcement, and polyester resin as polymeric matrix.

Braided reinforced composite rods were produced on a vertical braiding machine incorporating an impregnation system specially developed for this purpose. Different braided reinforced composite rods were produced maintaining the braided fabric structure and varying the type of core reinforcement fibre. Composite rods were reinforced with a single type of reinforcement fibres as well as with two and three types of fibres, varying the percentage of each type.

In order to evaluate the volume fraction of the different braided reinforced composite rods produced, tests were performed according to the Portuguese Standard NP 2216/1988 (determination of mass loss by calcinations of glass fibre reinforced plastics).

In order to evaluate the mechanical performance of the different braided reinforced composite rods produced, tensile tests were carried out according to ASTM D 3916-94 standard, with a

crosshead speed of 5 mm/min. A post-load of 50KN was applied to the rods prior to performing the tensile tests.

When compared to the steel rebars currently used in the construction industry, composite rods higher tensile strength. Current steel rebars, A235NL, A400NR/ER and A500NR/ER have values of tensile strength of 360 MPa, 460 MPa, and 550 MPa respectively. Composite rods present tensile strength higher than 550MPa. Even though the tensile strength braided reinforced composite rods is higher than that of steel rebars, composite rods have a lower modulus of elasticity when compared with the 210 GPa of steel rebars.

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